Equation Derivation and Verification Procedure
Wheeler Participatory Universe (It from Bit)

I. Equation Derivation

The Wheeler participatory universe addresses how physical reality ('It') emerges from informational acts ('Bit'). Observation is treated as a physical process whereby questions posed to a quantum system select outcomes that become classical reality.

The foundational participatory element is the choice operator Q_choice, represented as a sum of projection operators corresponding to admissible measurement questions. Each choice is dimensionless and represents a discrete act of participation.

The information capacity of the observer state is quantified by B_info = -k_B * sum(p_i * log(p_i)), where p_i are Born-rule probabilities derived from the observer state Psi_obs. This entropy sets the capacity for reality manifestation.

Manifestation is modeled via a projection of the field density operator according to rho -> Q_choice * rho * Q_choice_dagger, corresponding to the von Neumann measurement rule. This operation transforms quantum potentiality into classical actuality.

Delayed-choice phenomena are resolved using a retroactive unitary operator T_retro = exp(i * H_eff * tau / hbar). This does not imply backward causation; instead, past and present states are treated as timelike-entangled within a block-universe description.

The global structure of participation is represented by a self-excited circuit operator C_circuit, defined as the integral over cosmic time of all participatory acts. The universe is treated as a self-referential informational eigenstate.

Observation is physically defined via decoherence. The decoherence boundary operator D_boundary = Tr_env(rho_total) marks the transition from quantum coherence to classical record. Conscious observers are not required for collapse, but act as highly efficient decoherence sources.

II. Verification and Test Procedure

Test 1: Geometric Consistency. Verify that manifestation operators project onto stable geometric eigenstates and do not introduce spacetime singularities.

Test 2: Conservation and Symmetry. Confirm that no net energy or information is created. Manifested structure corresponds to reorganization of vacuum information, not creation ex nihilo.

Test 3: Causality. Demonstrate that delayed-choice effects arise from timelike entanglement rather than superluminal signaling or backward causation.

Test 4: Observation Criterion. Confirm that observation corresponds to irreversible decoherence, characterized by Tr(rho^2) < 1 for reduced states, and not to consciousness per se.

Passing all tests establishes the Wheeler participatory universe formalism as internally consistent, conservation-respecting, causality-safe, and suitable for archival and experimental discussion.